

NON-PUBLIC?: N
ACCESSION #: 9010010100
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Arkansas Nuclear One, Unit Two PAGE: 1 OF 05

DOCKET NUMBER: 05000368

TITLE: Failure of 125 Volt DC Solenoid Operated Valve Caused Inadvertent
Main Steam Isolation Valve Closure and Subsequent Reactor Trip
EVENT DATE: 08/21/90 LER #: 90-019-00 REPORT DATE: 09/20/90

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: Larry A. Taylor, Nuclear Safety TELEPHONE: (501) 964-3100
and Licensing Specialist

COMPONENT FAILURE DESCRIPTION:

CAUSE: X SYSTEM: JE COMPONENT: SOL MANUFACTURER: A499
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On August 21, 1990 at 0216 hours, while operating at full power the 'B' steam generator (S/G) main steam isolation valve (MSIV) closed fully resulting in an automatic reactor trip generated by the Core Protection Calculators (CPCs). The CPC trip was initiated due to a sensed temperature difference between the reactor coolant system (RCS) cold legs caused by the MSIV closure. The emergency feedwater system actuated automatically and was used to supply S/G feedwater for decay heat removal. The 'B' S/G main steam safety valves opened to limit S/G secondary pressure and reseated properly following the reactor trip. Other plant systems responded properly to the transient. Subsequent investigations revealed the MSIV closure was due to the failure of a normally energized, 125 volt DC solenoid on an air supply valve to the MSIV. The root cause of the solenoid failure could not be determined. The solenoid was replaced and the MSIV was stroke tested for operability.

Approximately one hour after the trip the indication on the 'A' S/G blowdown line radiation monitor was noted to be slightly elevated. Analysis of S/G secondary water confirmed that a very small primary to secondary leak existed. The leak rate stabilized at this value and has not increased. There was no actual safety significance as the result of this event.

END OF ABSTRACT

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A. Plant Status

At the time of occurrence of this event, Arkansas Nuclear One, Unit Two (ANO-2) was operating at 100 percent of rated thermal power in Mode 1 (Power Operation). Reactor Coolant System (RCS) AB! temperature was 580 degrees Fahrenheit and pressurizer pressure approximately 2250 psia.

B. Event Description

On August 21, 1990, at 0213 hours, a licensed control room operator observed the position indication for the 'B' steam generator (S/G) main steam isolation valve (MSIV) SB-ISV! was indicating the valve was in a mid position (less than full open). A few seconds later the valve returned to a full open position. At approximately 0216 hours the MSIV closed fully. The Shift Supervisor ordered the reactor to be manually tripped; however, before the manual trip could be initiated an automatic reactor trip was generated by the Core Protection Calculators (CPCs) JC!. Operations personnel responded to the transient by performing the immediate actions of the Emergency Operating Procedure.

All Control Element Assemblies (CEAs) inserted fully into the reactor core. The emergency feedwater (EFW) system BA! actuated automatically due to post reactor trip S/G water level response (shrink) with both EFW pumps starting and supplying feedwater to the S/G's. The main feedwater (MFW) control system JB! responded as designed to the reactor trip condition and the 'B' MFW pump and EFW system were used to restore S/G levels to normal. Due to the rapid closure of the MSIV all five main steam safety valves SB-RV! on the 'B' S/G opened to limit S/G secondary pressure. The 'B' S/G pressure reached a maximum value of approximately 1135 psia during the transient. The safety valves reseated properly when S/G pressure decreased following the reactor trip. The steam dump and bypass control system JI! responded by automatically opening steam

dump valves to the main condenser to control the 'A' S/G pressure.

At 0231 hours, a bypass valve around the closed 'B' S/G MSIV was opened to allow steaming of the isolated S/G to the main condenser for secondary side pressure control. Other plant systems responded properly to the transient. The plant was stabilized in a Mode 3 (Hot Standby) condition within approximately 30 minutes of the MSIV closure.

At approximately 0306 hours, while monitoring post trip plant conditions a control room operator noted that the indication for the 'A' S/G blowdown line radiation monitor IL! was trending upward slightly. The indication increased to slightly above the monitor alarm setpoint (approximately 200 cpm) and stabilized. Operations personnel instructed Chemistry to sample the S/G's and RCS.

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At 0605 hours, Chemistry notified the control room that the results of sampling and analysis indicated a very small primary to secondary leak in the 'A' S/G. Calculations based on the concentration of radioactive tritium in the secondary water indicated a calculated leak rate of approximately 1.15 gallons per day from the RCS to the S/G. Upon receipt of this information, the operations staff initiated additional actions to monitor secondary plant systems for radioactive contamination. Initial and subsequent surveys of selected plant areas by Health Physics personnel indicated no contamination due to the small primary to secondary system leak.

C. Root Cause

Each of the main steam (MS) lines penetrating the containment building is equipped with a main steam isolation valve provided to isolate the S/Gs from the rest of the secondary steam system in the event of a postulated MS line rupture. The MSIVs are air operated, spring loaded, Y-pattern globe valves designed to close fully from an open position in less than 3 seconds. The valves are held open by air pressure from the plants instrument air system LD!. The air supply line to each valve is equipped with two redundant, normally energized, 125 volt DC powered solenoid supply and vent valves

LD-SSV!. Deenergizing either valve will isolate the air supply to the MSIV and vent air pressure from the valve actuator allowing spring action to rapidly close the valve.

After stabilizing the plant in a hot standby condition, Operations

personnel attempted to open the 'B' S/G MSIV from the control room, however, the valve would not respond. Maintenance personnel investigated the problem and determined that the solenoid on one of the air supply valves (2SV-1060-2A) had an open coil circuit. Opening of the coil circuit resulted in deenergizing the solenoid which caused isolation of the air supply to the MSIV resulting in rapid closure of the valve.

As part of the troubleshooting effort to determine the cause of the solenoid failure the DC voltage level at the coil was checked and verified to be acceptable. The coil was removed from the valve and visually inspected. The coil appeared to be discolored around the leadin (power supply) wires indicating possible overheating of the component in this area. A review of maintenance history records revealed that the solenoid had been replaced approximately 30 days prior to its failure as part of scheduled replacement for environmental qualification purposes. Therefore, aging of the coil was not considered to be a factor related to its failure.

The failed coil was subsequently inadvertently discarded thereby preventing a detailed inspection and analysis of the component which might have revealed additional information as to the root cause of the failure. An evaluation of the design of the coil and the observed discoloration near the area of the coil leads determined that a likely cause may have been a failure or degradation of a soldered joint where the leads connect to the solenoid coil. The cause of such a failure mechanism could not be determined and it was concluded that this specific solenoid failure was most likely a random occurrence.

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D. Corrective Actions

The failed solenoid coil was replaced and the 'B' S/G MSIV was stroke tested to verify operability. Discussions were held with the manufacturer of the solenoid, research of relevant industry information (NPRDS, Nuclear Network, etc.) and review of ANO maintenance history records were conducted. The manufacturer stated that no previous failures of DC solenoids had been reported and no information was identified that would indicate this component failure might be a generic concern.

With respect to the indicated small primary to secondary leak, the frequency of S/G sampling and analysis was increased to closely monitor secondary activity. Trending of S/G secondary activity is

continuing and has not indicated any increase in leak rate.

E. Safety Significance

The Core Protection Calculators (CPCs) are a subsystem of the ANO-2 Reactor Protection System (RPS) JC! and are designed to provide automatic reactor trip signals to ensure specified acceptable fuel design limits (SAFDLs) are not exceeded as the result of Anticipated Operational Occurrences (AOOs). The closure of a single MSIV while operating at power causes a loss of load to the affected S/G resulting in an increase in its primary side temperature and pressure. The unaffected S/G accommodates the lost load causing its primary side temperature and pressure to decrease. The resulting coolant temperature asymmetry in the core is detected by the CPCs, which monitor the temperature difference (Delta T) between diagonally opposed RCS cold legs. If the Delta T measured by the CPCs exceeds a preset value, a trip signal is generated to ensure that radial power distribution asymmetries caused by the temperature differences do not allow the SAFDLs to be exceeded.

During this event the CPCs sensed the temperature difference between the RCS cold legs caused by the inadvertent closure of the 'B' MSIV and generated an automatic reactor trip as designed. Therefore no fuel design limits were approached or exceeded. The 'B' S/G safety valves opened as designed to prevent overpressurization of the isolated S/G and reseated properly. Reactor decay heat removal was provided by forced circulation with reactor coolant pumps and steaming the unaffected S/G to the main condenser. RCS inventory was adequately maintained throughout the event.

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With respect to the indicated small primary to secondary leak, the ANO-2 Technical Specifications (TS) allow plant operation with primary to secondary leakage of up to .5 gpm. The indicated leakage is extremely small and significantly less than that allowed by the TS. Additionally, no significant secondary system contamination has occurred as a result of the leak and the leak rate is not expected to increase.

Operator recognition of the initial change of state of the MSIV prior to its actual closure and prompt identification of the small increase in S/G secondary activity following the trip were determined to be indicative of appropriate overall response of the operating crew to the transient. Actions taken in response to the initiating event and subsequent reactor trip were both adequate and

timely. No procedural deficiencies were identified as the result of the event.

Based on evaluation of overall system response to the transient there was no actual safety significance to this event.

F. Basis for Reportability

This event resulted in an unplanned automatic actuation of the Reactor Protection System and the Emergency Feedwater System (an ESF) and is reportable per 10CFR50.73(a)(2)(iv). The event was reported per 10CFR50.72(B)(2)(ii) at 0324 on August 21, 1990.

G. Additional Information

There have been no previous similar events reported.

Energy Industry Identification System (EIIS) codes are identified in the text as XX!.

ATTACHMENT 1 TO 9010010100 PAGE 1 OF 1

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September 20, 1990

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U. S. Nuclear Regulatory Commission
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SUBJECT: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Licensee Event Report No. 50-368/90-019-00

Gentlemen:

In accordance with 10CFR50.73(a)(2)(iv), attached is the subject report concerning the failure of a solenoid on a 125 volt DC solenoid operated valve which caused an inadvertent main steam line isolation valve closure

and subsequent reactor trip.

Very truly yours,

James J. Fisicaro
Manager, Licensing

JJF/LAT/sgw

cc: Regional Administrator
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